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ABSTRACT

This student module on material hoist safety is one of 50 modules concerned with job safety and health. This module presents safety concerns related to electric, air, and manually operated chain hoists, as well as the design and erection requirements for inside and outside material hoistways. Following the introduction, eight objectives (each keyed to a page in the text) the student is expected to accomplish are listed (e.g., Explain the meaning of a safety factor). Then each objective is taught in detail, sometimes accompanied by illustrations. Learning activities are included. A list of references and answers to learning activities complete the module. (CT)

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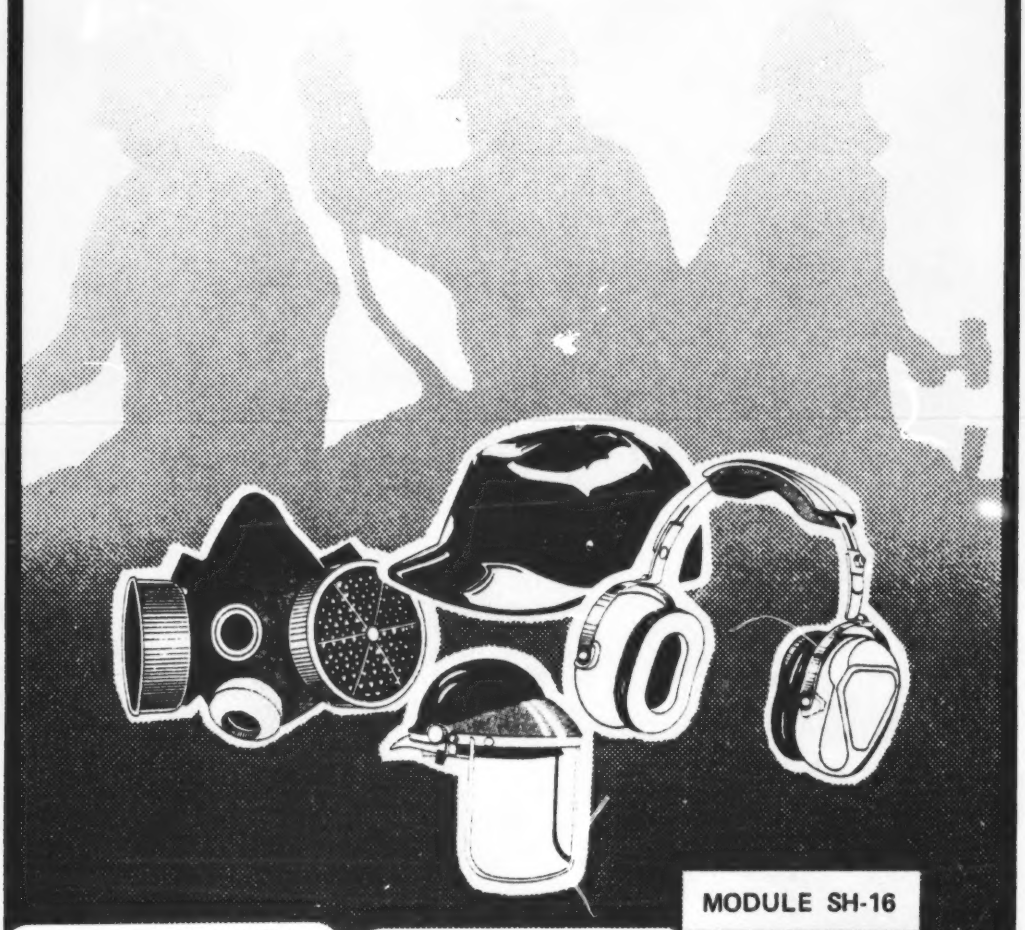
SAFETY AND HEALTH

MATERIAL HOIST SAFETY



MODULE SH-16

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INTRODUCTION

The concept of using a rope and a pulley to diminish the energy required to lift a load is centuries old. Without hoisting devices of some kind, the great pyramids of Egypt might never have been built. The rope, pulley, and water bucket at the water well was part of American farm life, and in many places in rural America, this ancient hoisting device is still making it easier to "draw" a pail of water.

Presently in the construction of modern high rise buildings, the use of hoisting equipment is essential to raise large amounts of equipment and materials, as well as personnel, to the upper levels. The size of modern industrial hoisting equipment ranges from huge hammerhead cranes to simple, manually-operated chain hoists. In every case, hoists are designed for specific jobs. When they are used safely within their limitations, hoists seem to accomplish miracles; when used unsafely or carelessly, they can be the most dangerous of machines.

This module addresses material hoists safety. Specifically, it presents safety concerns related to electric, air, and manually-operated chain hoists, as well as the design and erection requirements for inside and outside material hoistways. The meaning of a safety factor of five is explained, and information about the selection and maintenance of hoisting ropes is presented.

OBJECTIVES

Upon completion of this module, the student should be able to:

1. Describe three types of material hoists. (Page 3)
2. Explain the meaning of a safety factor. (Page 4)
3. List three safety features for each type of material hoist. (Page 5)
4. Identify the basic safety requirements for material hoists, including four design-related requirements. (Page 8)
5. Discuss factors that should be considered in rope selection for material hoists. (Page 13)

6. List the four requirements for entrance protection for material hoistways. (Page 17)
7. Describe two safety features that should be found on entrance gates to material hoistways. (Page 18)
8. Cite two additional factors to be considered in the safety of material hoistways. (Page 20)

OBJECTIVE 1:* List three types of material hoists.

Material hoists are devices for moving materials from one area to another, or from one level to another; they may be fixed (permanently installed) or portable, large or small. Most modern industrial material hoists are designed for specific jobs, and although there are literally thousands of them, most of them range from 1/4 to one ton in capacity and fall into one of three categories. There are electric hoists, air hoists, and hand-operated chain hoists. (See Figure 1.) Electric hoists and air hoists are often permanently installed at a work station because they are designed to lift heavier loads. Hand-operated chain hoists are usually portable, very versatile, and more common in a variety of work areas than other types of hoists. Hand-operated chain hoists can also be hooked permanently onto an overhead monorail trolley, or built into the trolley as an integrated part.

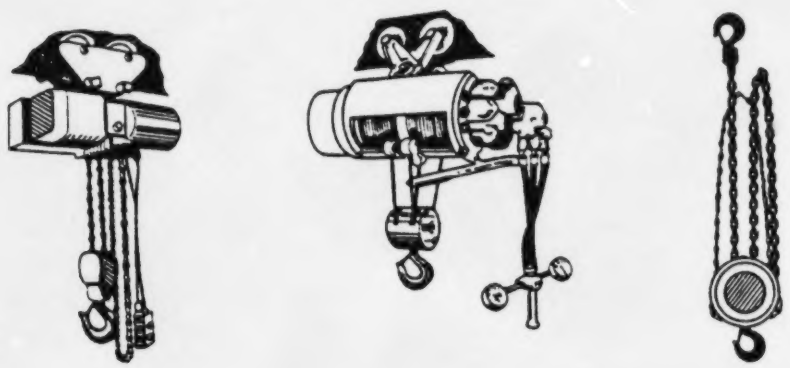

Figure 1. Three types of hoists.

Another attractive quality of hand-operated chain hoists is that they are suitable for many load-lifting operations that might normally use a block and tackle fitted with manila rope. In such an operation, the hand-

operated chain hoist serves the purpose better because it is stronger, more durable, and therefore more dependable than block, tackle and rope.

ACTIVITY 1:

1. List the three types of material hoists.
   a. _____
   b. _____
   c. _____
2. What is the type of material hoist most common in industry? _____

OBJECTIVE 2: Explain the meaning of a safety factor.

Safe load limits for material handling devices are determined in experimental situations. These "ideal conditions" are often not the same as those encountered in an actual work site; therefore, a safety factor is used to compensate for this. Assigning a numbered safety factor is a way of relating the breaking strength of a piece of equipment or material to the maximum permissible stress when the equipment or material is in use.

The formula for establishing a factor of safety is a complex one. However, a general rule for hoisting purposes is that it is not advisable for the total working load on a hoist or hoist platform to exceed 1/5 of its breaking strength. This rule is known as a safety factor of five. In other words, if a material hoist has a breaking strength of 4000 pounds and is designed with a safety factor of five, the hoist should carry no more than 1/5 of 4000 pounds. The maximum permissible stress or the maximum safe load, would thus be 800 pounds.

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*Answers to Activities begin on Page 21.

ACTIVITY 2:

(Circle the correct answer.)

A general rule for hoisting purposes is that the total working load on a hoist or hoist platform should not exceed how much of its breaking strength?

1. 1/3.
2. 1/4.
3. 1/5.

OBJECTIVE 3: List three safety features for each type of material hoist.

Some general safety rules should be applied to the use of all types of material hoists. The first of these safety rules concerns the need for regular inspection. Whether a hoist is operated by electricity, by air, or by hand, it should be inspected in detail at regular intervals - on a daily basis, if needed. Inspectors should pay special attention to load hooks, cables, chains, brakes, and limit switches. Since material hoists all have safety factors, the load capacity of each hoist should be shown in conspicious figures on both sides of the machine.

Other general safety rules for hoists call for all hoists to be attached to their supports (whether fixed member or trolley) with shackles. Support hooks should have safety latches, as should load hooks.

Extra protection against failure of the supporting hook, shackle, or block can be provided by a retaining cable. This cable should be looped around the body of the hoist and through the support, as shown in Figure 2.

One very important rule to remember about all material hoists operations is that a load should be picked up only when it is directly under the hoist. Otherwise, the hoist will be subjected to stresses for which it is not designed.

Some specific features have been designed to increase the safety of each type of material hoist, and a discussion of these follows.

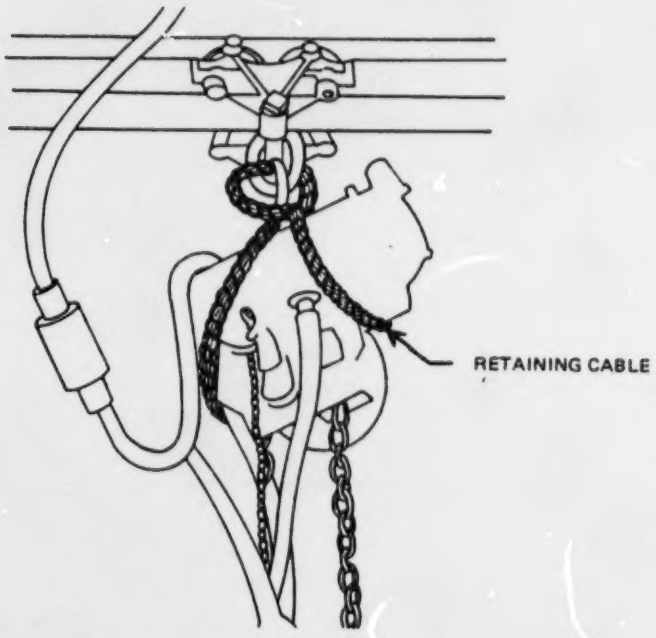

Figure 2. Retaining cable protects against failure of supporting hook, shackle, or block.

ELECTRIC HOISTS

Electric hoists, unless they are grounded, should have nonconducting control cords. Control cords should have handles of distinctly different contours so that the operator will know by "feel" whether he is hoisting or lowering the load. Ropes should be clearly marked "hoist" or "lower." Some companies attach an arrow to each control rope to point out the direction in which the load will move when a rope is pulled.

In some situations, it is wise to pass the control ropes through a spreader to keep them from becoming tangled. In all cases, control ropes should be inspected weekly for wear or other defects.

Floor-operated electric hoists should have a safety device that will cause an automatic return to "off" and thus stop the hoist unless a constant pull is maintained on the control button. Pushbutton control circuits should be limited to 110-120 volts. An electric hoist should also have a stop limit device installed on the hoist motion, so that at least two turns of rope will remain on the drum when the load block is on the floor.

AIR HOISTS

One basic hazard with an air hoist is that the locknut that holds the piston on its rod may become so loose that the piston will pull out of the rod and drop the load. To avoid this possibility, the locknut should be secured to the piston rod with a castellated nut (a nut with slots cut in the top through which a cotter pin can be inserted to hold the nut in place) and cotter pin. (See Figure 2.) This is an important item to check during inspections or at any time the hoist is repaired or overhauled.

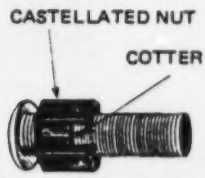

Figure 3. Castellated nut with cotter pin.

If an ordinary hook is used to hang an air hoist from its support, a clevis (a V-shaped metal shackle and pin) or other restraining device should be used to prevent the hook from coming loose from the hoist support. To prevent an air hoist from hoisting or lowering too fast, a choke should be placed in the air line. This is accomplished by placing a washer with the correct opening in the air line coupling.

Air hoists have many more manual safety features than other types of hoists; in particular, there are two more items that OSHA (Occupational Safety and Health Administration) requires for air hoist operations. First, air hoists should be connected to an air supply of sufficient capacity and pressure to safely operate the hoist. This means that pressure gages on air tanks should be inspected at regular intervals to be sure they are registering the right pressure. Second, OSHA specifies that air hoses supplying air to air hoists should be connected using positive connections only, to prevent their becoming disconnected during use. Supply hoses should also be inspected at regular intervals. A defective hose could blow and cause the load to drop, or permit a loose end of the hose to snap wildly about under high pressure and seriously hurt somebody.

CHAIN HOISTS

A chain hoist should be of greater capacity than the regular work it is required to do. Load-sustaining parts of chain hoists should not be made of cast iron or other metals that will not withstand a sudden shock. Steel

is sufficiently ductile (has a capacity to adapt to change) to absorb a sudden shock, and load-sustaining parts should be made of steel. Hoist supports must also be strong enough to carry the load imposed on them, and supports should be inspected regularly.

Hoist chains should be made of the best quality welded steel with a load safety factor of five. Load sheaves should have no fewer than five accurately formed pockets for seating the chain. (A sheave is a grooved wheel used to change the direction of the hoisting rope.)

One final note of safety about hand-operated chain hoists: proper lifting procedures must be followed to avoid strain or injury to the operator.

ACTIVITY 3:

1. List one safety factor each for portable chain hoists and for electric hoists.
   a. _____
   _____
   b. _____
   _____
2. What two parts of an air hoist's supply system should be inspected regularly?
   a. _____
   b. _____ _____

OBJECTIVE 4: Identify the basic safety requirements for material hoists, including four design-related requirements.

A different type of material hoist is one that is constructed like an elevator (see Figure 4). This type of material hoist may be erected in a hoistway inside a building or in an outside tower. All material hoistways of this type should be designed by a licensed professional engineer and

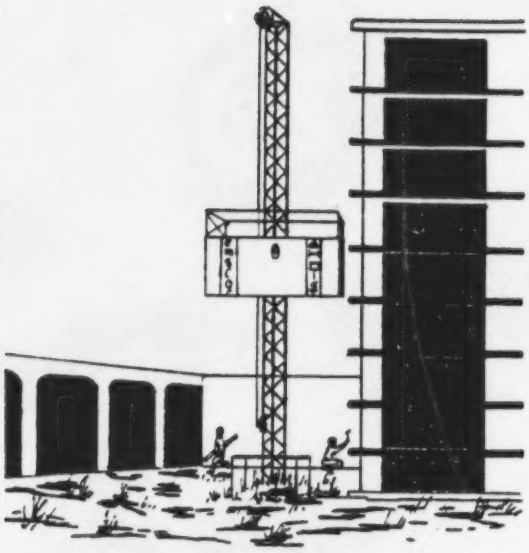

Figure 4. Elevator-type outside material hoist.

erected according to the manufacturer's specifications. When the manufacturer's specifications are not available, a professional engineer should determine load limitations, and these limitations must be strictly followed. This is a primary safety requirement.

Another basic safety requirement of all material hoists concerns the counterweight. Weight must be added to an unloaded hook to allow it to lower, or overhaul, through the system. This weight factor is called the counterweight and is normally determined by the manufacturer's specifications. Extra weight must never be added to a specified counterweight to increase the lowering speed. Extra weight will increase the wear on cables and on all moving parts and will impair the proper functioning of safety devices.

As the name implies, a material hoist is made for moving materials, not workers. For safety, only those workers involved in maintenance and inspection activities related to the hoist itself are allowed to ride a material hoist. The statement "No Riders Allowed" must be posted in a conspicuous location on the car frame.

Besides adhering to these basic safety requirements related to design and erection, material hoistways must follow other requirements. The hoistways must have rated load capacities, recommended operating speeds, and special hazard warnings or instructions posted on cars and platforms.

OSHA requires any material hoist to have a signal system. Whistle signals around hoisting activities are dangerous because they are easy to confuse with other noises. Hand signals function well when the operator can clearly see the signalman, but there is a better way. A mechanical bell at the engine, operated by pulling a wire, or even a light operated by a pull

wire, is much more satisfactory. Lights or bells, when used, should have preset meanings for each bell sound or each light flash:

- 1 bell or light = stop.
- 2 bells or lights = raise.
- 3 bells or lights = lower.
- 4 bells or lights = lower slowly.
- A rapid series of lights or bells means EMERGENCY STOP!

The condition of wire ropes used in material hoists is a primary safety consideration. Factors in the selection of wire ropes and features that indicate wear and end of rope service are described in Objective 5.

All entrances of hoistways must be protected by substantial gates or bars that must guard the full width of the landing entrance. Latching devices are required on bars or gates that protect entrances; and these and other requirements for entrance will be discussed in Objective 6.

Overhead protective covering must be provided on the top of every material hoist cage or platform. The protective covering must be two-inch planking, 3/4-inch plywood, or other solid material of equivalent strength. In addition to overhead protection for the cage or platform, the operator's station of a hoisting machine must be provided with overhead protection equivalent to tight planking no less than two inches thick, and the support for the overhead section must be of equal strength.

INSIDE MATERIAL HOISTWAYS

In addition to the general requirements for all material hoistways, other standards must be met for material hoistways constructed inside a building. The shaftways of inside material hoists may be solidly enclosed, but in cases where they are not, they must be constructed to meet certain requirements. When a hoist tower is enclosed, it must be enclosed on all sides, throughout its entire height, with a screen enclosure of half-inch mesh, No. 18 U.S. gage wire or equivalent, except for the landing access.

When a hoist tower is not enclosed, the hoist platform or car must be totally enclosed (caged) on all sides, for the full height between the floor and the overhead protective covering, with half-inch mesh of No. 14 U.S.

gage wire or equivalent. The hoist platform enclosure must include the required gates for loading and unloading, and a six-foot high enclosure must be provided on the unused sides of the hoist tower at ground level.

OUTSIDE MATERIAL HOISTWAYS

For outside material hoists, a number of different factors must be considered. The most important difference between inside and outside hoistways is that an outside hoistway is especially subject to stress from wind. This factor is called "wind loading" and should be carefully considered at the time an outside hoistway is erected.

In certain climates, the wind loading factor may be very high, but in all cases, this factor demands that an outside hoistway design be based on a safety factor of at least five. (A safety factor of five means that the hoistway must be constructed to withstand five times the actual working stress when in use.) Another essential for an outside hoistway is that the tower should be on a level and solid foundation and should be well guyed or fastened to the building.

Because the safety factor of five is required, foundation footings for outside hoistways should be carefully designed. Since the tower must be vertically plumb and extend at least 20 feet beyond the top of the building, even a slight movement of a foundation footing could seriously impair safe operation of the hoistway. It could also diminish the safety factor to the point that the hoistway would have to be shut down.

All hoistways or towers should be cross-braced, and firmly anchored to the building. In cases where hoistways or towers are erected independent of the building, they should be guyed at each corner every 25 feet in height, with a wire rope at least half an inch in diameter.

Under no circumstances should guy wires ever be attached to reinforcing steel that projects through the floor in freshly poured concrete, or to other insecure portions of new work. The lower end of guy wires should be carefully protected from damage by moving vehicles. If the lower end of a guy wire has to be positioned so that it might be subject to damage from moving vehicles, a proper barricade with warning lights should be placed around the guy wire end. Close working conditions sometimes demand that guy

wires cross public streets or passageways. In such situations, guy wires should leave adequate clearance for traffic and they should be marked with warning or clearance lights.

An outside material hoistway should be enclosed with heavy wire screening and should be equipped with a fixed ladder extending the full length of the tower. Where landing platforms connect the hoistway to the building, the platforms should be constructed of strong material capable of sustaining the maximum possible load. Landing platforms should also have standard guard rails and toeboards.

Hoistway towers may be constructed of tubular steel or wood. When towers are made of wood, splices (joins) in posts (upright timbers) should be staggered, and made with cleats at least two inches thick by four feet long.

ACTIVITY 4:

1. List four basic safety features of any material hoist.
   a. _____
   b. _____
   c. _____
   d. _____
2. Mark each statement True or False.

True	False	a.	A bell system provides clearer signals than a whistle system.
True	False	b.	The condition of wire ropes is an important safety consideration for material hoists.
True	False	c.	Counterweights sometimes require additional weight to speed lowering of the hoist.
True	False	d.	Special hazard warnings must be posted on hoist cars and platform.
True	False	e.	All material hoists must have rated load capacities.

True False f. "No Riders Allowed" refers to the general public only, and workers on the job site may freely use the material hoist.

3. What is the safety factor on which an outside material hoistway is based? _____

4. What precautions should be taken with regard to guy wires that must cross public streets?

   a. _____

   b. _____

5. Regarding outside material hoistways, what is meant by wind loading? _____

   _____

OBJECTIVE 5: Discuss factors that should be considered in rope selection for material hoists.

The choice of ropes to be used in hoisting operations is a significant factor in the overall safety of the hoist. In selecting hoisting rope, it should be remembered that ropes used in material hoistways are especially subject to fatigue. Fatigue is the name given to the wear caused by the constant bending of the rope over sheaves and around drums. As explained earlier, a sheave is a grooved wheel used to change the direction of a hoisting rope. The best rope for use in material hoistways is a round strand wire rope of grade 110/120 Improved Plow. This grade of rope has good fatigue resistance as well as good wearing qualities.

Another element in selecting a good hoisting is the assurance that the "rope lay" (see Figure 5) is the most appropriate for the intended service. A rope with a "regular lay" has wires in the strands laid in one direction, while the strands in the rope are laid in the opposite direction. In a wire

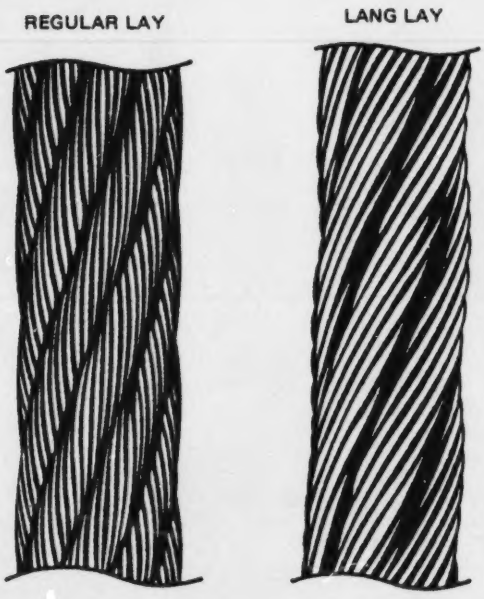

Figure 5. Examples of regular and Lang lay rope.

rope with a "Lang lay," the wires in the strands, as well as the strands in the rope, are laid in the same direction. Ropes with a "Lang lay" should not be used on single part hoistlines due to their tendency to kink and untwist, even though they have great resistance to fatigue. Regular lay wire ropes generally provide the best service for a material hoist because they can withstand considerable crushing and distortion, they have good resistance to kinking and twisting, and they are easy to handle.

The correct use of the drum on which the wire is wound is another important safety factor. Base-mounted drums used in hoisting are required to be installed, operated, inspected, and maintained according to manufacturer's specifications. The way in which the wire rope is wound on the drum is the basis of good rope service as well as rope safety. The basic rule to getting started right is to wind the rope from the reel onto the drum so that it bends in the same direction. In other words, the wire should be reeled from the top of the reel to the top of the drum, and reeled from the bottom of the reel to the bottom of the drum. Bracing a plank against the reel to keep tension on the rope helps it spool onto the drum firmly.

The size of the sheave or sheaves used in a material hoist operation must also be considered. Rope fatigue caused by the rope traveling over sharp bends can be lessened by the use of the largest diameter sheave that is practical. The size and condition of the groove in a sheave is also an important factor in long rope life and in safe service. A groove that is

too large will cause a hoist rope to flatten; a groove that is too small will pinch the rope. Figure 6 shows sheave and rope relationship.

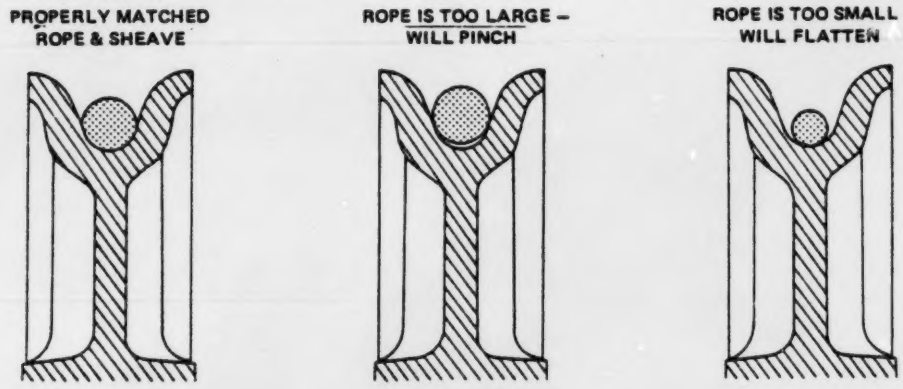

Figure 6. Rope and sheave should be properly matched.

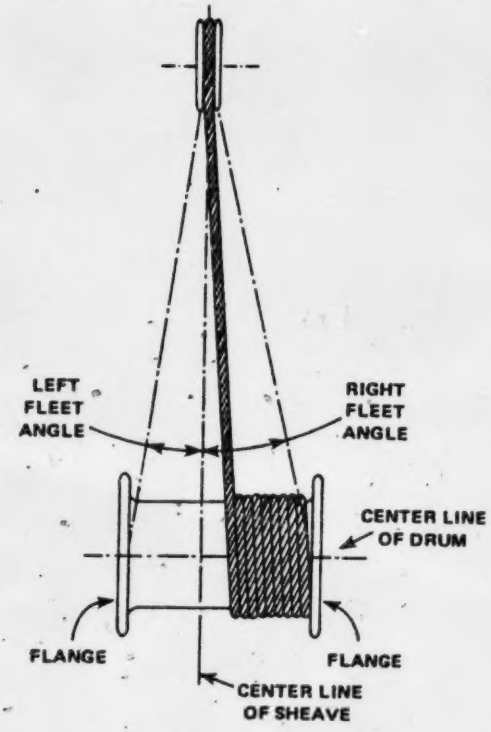

Figure 7. Fleet angle.

Another important aspect of hoisting design is the relationship between sheave, drum, and rope. This relationship is known as the "fleet angle" (Figure 7). The fleet angle is defined as the angle between two lines, one drawn from the center of the sheave through one flange of the drum, and the other through the center of the sheave to the center of the drum. In Figure 7, if the fleet angle were too far to the right or left, the rope would wear a groove in the sheave. If the fleet angle were too limited right or left, it would cause the rope to pile up at one flange of the drum.

Careful sheave inspection will reveal wear in the sheave groove if the rope is too small. Wear along

the flanges of the sheave groove indicates an improper fleet angle or a rope too large for the sheave. Sheave groove gages are available especially for this type of inspection. (See Figure 8.)

Bearings on sheaves should be carefully inspected, too. Bearings should rotate freely. A bearing that wobbles is a sure sign of other problems in the rope, sheave, and drum relationship. A bearing that wobbles excessively indicates that the sheave should be replaced. The bearing should be checked for lubrication, too.

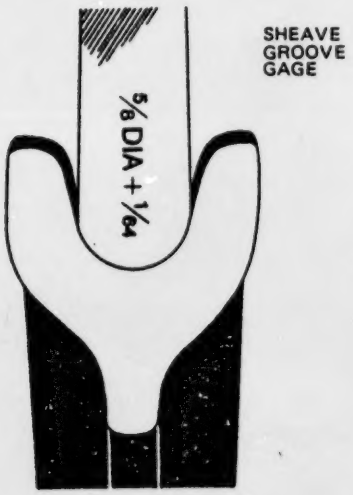

Figure 8. Careful sheave groove inspection is accomplished with sheave groove gage.

Lack of lubrication may be a result of normal operation and may indicate nothing more than a need for more lubrication. However, the operator must be sure that the lack of lubrication has not contributed to excessive bearing wear.

Wire hoisting rope must be removed from service when any one of the following conditions exists:

- When there are six randomly distributed broken wires in one rope lay, or three broken wires in one strand of one rope lay. (A rope lay is the distance measured along a rope in which a strand makes one complete revolution about the rope's axis.)
- When one-third of the original diameter of the outside wires is lost because of abrasion, scrubbing, flattening, or preening.
- When there has been a reduction from the original diameter of more than 3/64 of an inch for wire ropes of diameters up to and including 3/4 of an inch.
- When the reduction from the original diameter is 1/16 of an inch for ropes with diameters from 7/8 of an inch to 1 1/8 inches.
- When the reduction from the original diameter is 3/32 of an inch for ropes with diameters from 1 1/4 to 1 1/2 inches.

ACTIVITY 5:

(Fill in the blanks.)

1. The best rope for service in material hoists is _____
2. "_____lay" wire ropes are better than "Lang lay" ropes for material hoisting.
3. The way in which the wire rope is _____ on the drum is the basis of good rope service as well as rope safety.
4. Rope fatigue caused by the rope traveling over sharp bends can be reduced by the use of the _____ _____ diameter sheave available with the proper sheave groove.
5. Wire rope should be observed for broken wires and reduction in _____.

OBJECTIVE 6: List the four requirements for entrance protection for material hoistways.

All entrances to elevator-type material hoistways must be protected by substantial gates or bars to guard the full width of the landing entrance. (See Figure 9.) As well as this general requirement, there are other specific requirements for entrance protection to material hoistways:

1. All hoistway entrance bars and gates should be painted with diagonal contrasting colors, such as yellow and black stripes.
2. Bars must not be less than two-by-four inch wooden bars or the equivalent, and must be located at least two feet from the hoistway line.
3. Gates or bars protecting the entrance to hoistways should be equipped with latching devices.
4. Bars should be located not less than 36 inches, nor more than 42 inches, above the floor. This distance from the floor will prevent a person of average height from slipping under or falling over the bar.

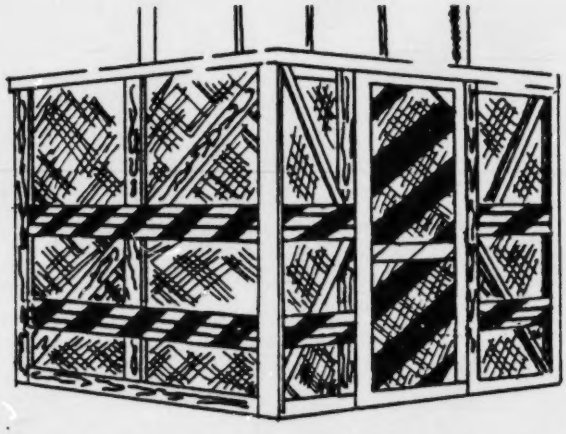

Figure 9. Hoistway entrance bars and gates should be painted with diagonal contrasting colors.

ACTIVITY 6:

(Fill in the blanks.)

1. An entrance bar to a material hoistway must be not less than 36 inches from the floor so nobody can trip over it. Why must it be no more than 42 inches above the floor? _____

   _____

2. What kinds of locks should be provided for personnel hoists or gates of the car itself? _____ _____

   _____

OBJECTIVE 7: Describe two safety features that should be found on entrance gates to material hoistways.

Since both gates and bars can be used at entrances of material hoists, it is good to have an idea of how both of them work. Gates can be constructed of solid wood or made from wooden slats, and they should be counterweighted and have locking or latching mechanisms. A single wood bar is sometimes used at entrances, and when it is, it should be attached perma-

nently by a hinge at one end and should have a receiver of substantial construction at the other.

Whether it is a wooden gate or a single bar, two essential safety features are the counterweight and the locking or latching mechanism. The locked or latched gate indicates to everyone that it is unsafe to enter the shaftway, and the counterweight assures that the gate will close by itself after the hoist has left the entrance.

The required entrance bars or gates are extremely important to safety. Without them, workers not paying attention, or those who slip or trip, could actually fall down an open hatchway.

It has been noted (in Objective 6) that hoistway entrance bars and gates should be painted with diagonal, contrasting colors. Yellow and black are the traditional colors used, but red and which or some other combination of colors could be used. Whatever the color coding, the color should be highly visible so that it will serve as an alarm for anyone approaching the gate area.

One of the hazards around gates is that of getting caught in the doors. This hazard can result from slipping and tripping, but it is more frequently a result of improper work dress. Workers should avoid wearing loose clothing when opening gates. Hair should be tied back if it is long, and shoelaces should be securely tied before the gate area is entered. Rags sticking out of pockets should also be removed. Finally, in any part of a construction area, it is wise to wear a hard hat that does not fall off every time you bend over. Instinctively reaching out to catch a falling hard hat can cause injuries in the workplace.

ACTIVITY 7:

Name two safety features that should be found on entrance gates to material hoistways.

1. _____
2. _____

OBJECTIVE 8: Cite two additional factors to be considered in the safety of material hoistways.

Material hoist platforms usually move up and down a shaftway on a cable. Naturally, these car cables should be carefully inspected at regular intervals. However, to guard against any possibility that a car cable should break, there should also be a safety stop.

On many material hoistways, the car is equipped with a broken-rope type of safety device. In the event that the car cable breaks, the safety device throws safety clamps into position on the guide rails along the shaftway and brings the car to an emergency stop. Should a car cable break, an overweighted counterbalance could cause the car to move at too fast a rate for the safety clamps to get a good grab on the guide rails. This is one reason it is important that no material hoistway be counterbalanced with more weight than specified by the designing engineer.

An additional safety factor to be considerd in material hoists is the type of flooring used. Because they receive excessive abuse from the movement of heavy materials in and out, all material hoist platforms should be constructed with substantial flooring.

Flooring should be of not less than 2-inch timber. The sides that will not be used for loading should be enclosed with heavy wire screening and have six-inch toeboards.

ACTIVITY 8:

(Circle True or False.)

1. Car cables of material hoist platforms should be inspected regularly.

   True False

2. A broken-rope safety device causes the car cable to break.

   True False

3. The flooring of a materials hoist platform should be substantial.

True False

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ANSWERS TO ACTIVITIES

ACTIVITY 1

1. a. Electric hoists.
   b. Air hoists.
   c. Hand-operated chain hoists.
2. Hand-operated chain hoists.

ACTIVITY 2

3. 1/5.

ACTIVITY 3

1. a. Electric hoists - nonconducting control cords, ropes marked hoist or lower, stop limit device. (Any one.)
   b. Portable chain hoists - must be of larger capacity than the regular work requires, sheaves should have five pockets. (Any one.)

2. a. Pressure gages.
   b. Supply hoses.

ACTIVITY 4

1. a. Hoist tower enclosure.
   b. Entrance protection.
   c. Gates that latch securely.
   d. Protective covering for operators.
2. a. True.
   b. True.
   c. False.
   d. True.
   e. True.
   f. False.
3. Safety factor of five.
4. a. Leave clearance for traffic.
   b. Mark with warning or clearance lights.
5. The stress the hois is subject to from wind.

ACTIVITY 5

1. Round strand wire rope of grade 110/120 Improved Plow.
2. Regular lay.
3. Wound.
4. Largest.
5. Diameter.

ACTIVITY 6

1. So that no one should slip under or fall over it.
2. Mechanical locks that cannot be operated from the landing side.

ACTIVITY 7

1. Counterweights.
2. Locking or latching mechanisms.

ACTIVITY 8

1. True.
2. False.
3. True.